

Claims

- [c1] An apparatus located above a wellhead to allow a communications conduit to enter a drillstring, the apparatus comprising:
 - a main body having an upper end and a lower end, said lower end including a lower connection to the drillstring and said upper end providing an upper connection to the drillstring and an entry port;
 - an articulated knuckle joint to allow deflection of said main body relative to said lower connection to the drillstring;
 - said main body configured to provide fluid communication between said upper connection and said lower connection; and
 - a communications pathway extending through said main body from said entry port to said lower connection wherein said pathway is configured to receive the communications conduit therethrough.
- [c2] The entry device of claim 1 further comprising a second articulated knuckle joint to allow deflection of said main body relative to said upper connection to the drillstring.
- [c3] The apparatus of claim 1 wherein said articulated

knuckle joint restricts relative rotation between said lower connection to the drillstring and said main body.

- [c4] The apparatus of claim 1 wherein said articulated knuckle joint permits relative rotation between said lower connection to the drillstring and said main body.
- [c5] The apparatus of claim 1 further comprising one or more downhole tools attached at a distal end of the communications conduit.
- [c6] The apparatus of claim 1 wherein said main body and said articulated knuckle joint are configured to transmit tensile drillstring loads from between said upper connection and said lower connection of the drillstring.
- [c7] The apparatus of claim 1 wherein said articulated knuckle joint prevents bending moment loads from acting across said main body.
- [c8] The apparatus of claim 1. wherein said communications pathway is substantially coaxial with said lower connection to the drillstring when tools disposed upon said communications conduit are passed therethrough.
- [c9] The apparatus of claim 1 wherein said communications pathway and said lower connection to the drillstring are axially skewed when tension loads are applied across

said upper and said lower connections to the drillstring.

- [c10] The apparatus of claim 1 wherein said communication pathway includes a receiving profile.
- [c11] The apparatus of claim 10 wherein said receiving profile includes a hardened, wear-resistant material.
- [c12] The apparatus of claim 10 wherein said receiving profile includes a replaceable wear sleeve.
- [c13] The apparatus of claim 1 wherein said articulated knuckle joint includes a replaceable wear sleeve.
- [c14] The apparatus of claim 1 wherein the communications conduit is selected from the group consisting of wireline, coiled tubing, fiber optic cable, braided wire, and slick line.
- [c15] An apparatus located above a wellhead to allow a communications conduit to enter a drillstring, the apparatus comprising:
 - a main body having an upper end and a lower end, said lower end including a lower connection to the drillstring and said upper end providing an upper connection to the drillstring and an entry port;
 - an articulated knuckle joint to allow deflection of said main body relative to said upper connection to the

drillstring;
said main body configured to provide fluid communication between said upper connection and said lower connection; and
a communications pathway extending through said main body from said entry port to said lower connection wherein said pathway is configured to receive the communications conduit therethrough.

- [c16] An improved entry sub located above a wellhead to allow the insertion and removal of tools disposed upon a distal end of a communications conduit, the improvement comprising:
 - an articulated knuckle joint configured to allow relative deflection between the top entry sub and the drillstring, wherein the said articulated knuckle joint prevents bending moment loads from acting across the top entry sub.
- [c17] The improved entry sub of claim 16 wherein the articulated knuckle joint is located between the entry sub and a lower connection to the drillstring.
- [c18] The improved entry sub of claim 16 wherein the articulated knuckle joint is located between the entry sub and an upper connection to the drillstring.

- [c19] The improved entry sub of claim 16 further comprising a second articulated knuckle joint, wherein one articulated knuckle joint is located between the entry sub and an upper connection to the drillstring and another articulated knuckle joint is located between the entry sub and a lower connection to the drillstring.
- [c20] The improved entry sub of claim 16 wherein the entry sub is a top entry sub.
- [c21] The improved entry sub of claim 16 wherein the entry sub is a side entry sub.
- [c22] The improved entry sub of claim 16 wherein a communications pathway is substantially coaxial with a lower connection to the drillstring when the tools disposed upon the communications conduit are passed therethrough.
- [c23] The improved entry sub of claim 16 wherein a communications pathway is axially skewed from a lower connection to the drillstring when the drillstring is in tension.
- [c24] A method to deploy tools connected to a distal end of a communications conduit into a drillstring, the method comprising:
 - connecting an articulatable entry sub to the drillstring,

the articulatable entry sub providing an entry port, an upper connection to the drillstring, a lower connection to the drillstring, and an articulated knuckle joint, wherein the entry port is connected to the lower connection of the drillstring by a communications pathway;

positioning the articulatable entry sub so the communications pathway and the lower connection to the drillstring are substantially coaxial;

engaging tools through the entry port of the articulatable entry sub, through the communications pathway, through the lower connection to the drillstring, and into a portion of the drillstring located below the articulatable entry sub; and

positioning the articulatable entry sub so the communications pathway is axially skewed from the lower connection to the drillstring.

- [c25] The method of claim 24 further comprising axially loading the drillstring across the articulatable entry sub when the communications pathway is axially skewed from the lower connection to the drillstring.
- [c26] The method of claim 24 wherein the articulatable entry sub further comprises a second articulated knuckle joint, wherein an articulated knuckle joint is located at the upper connection to the drillstring and the second articu-

lated knuckle joint is located at the lower connection to the drillstring.

- [c27] The method of claim 24 further comprising shifting the communications pathway from coaxial to skewed alignment with the lower connection to the drillstring by applying a tensile load to the drillstring across the articulatable entry sub.
- [c28] An entry sub comprising:
 - a tubular member with opposed articulating joints at respective first and second ends thereof;
 - a first longitudinal passage in the tubular member opening at the joint at the first end;
 - a second longitudinal passage in the tubular member diverging from the first longitudinal passage and in communication between the first longitudinal passage and the joint at the second end;
 - a third longitudinal passage in the tubular member in communication between the first longitudinal passage and a port in the second end of the tubular member.
- [c29] The entry sub of claim 28 wherein the articulating joints comprise deflection knuckles.
- [c30] The entry sub of claim 28 wherein the articulating joints

comprise swivels to provide for rotation of the tubular member about a longitudinal axis with respect to the joints.

- [c31] The entry sub of claim 28 further comprising a wear sleeve in the joint at the first end.
- [c32] The entry sub of claim 28 wherein the joints are articulatable into axial alignment under tension.
- [c33] The entry sub of claim 28 wherein the joints include drill pipe connections.
- [c34] The entry sub of claim 33 wherein the port at the second end includes a wireline entry connection.
- [c35] The entry sub of claim 28 wherein the joints are articulatable between a first position wherein the joints are in alignment with a longitudinal axis and the port at the second end is offset from the axis, and a second position wherein the joint at the first end is axially aligned with the port at the second end and the joint at the second end is offset from the axis.
- [c36] The entry sub of claim 28 further comprising a coaxial bore defining the first and third longitudinal passages and a divergent intersecting bore defining the second longitudinal passage.

- [c37] An articulated top entry sub, comprising:
 - a tubular member;
 - a first longitudinal bore into the member from a lower drillstring port at a lower end;
 - a second longitudinal bore into the member from a wireline entry port at an upper end to communicate with the first longitudinal bore;
 - a third longitudinal bore from an upper drillstring port at the upper end to communicate with the first longitudinal bore at a divergent angle;
 - an upper drillstring connection sub having a lower end terminating at an upper deflection joint in the upper drillstring port having a maximum deflection angle at least as great as the divergent angle; and
 - a lower drillstring connection sub having an upper end terminating at a lower deflection joint in the lower drillstring port having a maximum deflection angle at least as great as the divergent angle.
- [c38] The articulated top entry sub of claim 37 wherein the deflection joints comprise knuckle joints.
- [c39] The articulated top entry sub of claim 37 wherein the deflection joints comprise ball joints.
- [c40] The articulated top entry sub of claim 39 wherein the

deflection joints provide for rotation of at least one of the drillstring connections with respect to the tubular member.

- [c41] The articulated top entry sub of claim 37 wherein the first and second longitudinal bores are coaxial.
- [c42] The articulated top entry sub of claim 41 wherein the coaxial bores have the same inside diameter to provide a continuous bore through the longitudinal member.
- [c43] The articulated top entry sub of claim 37 wherein the first and second longitudinal bores are divergent.
- [c44] The articulated top entry sub of claim 37 wherein the joints each comprise:
 - a sleeve formed in each respective drillstring port having an annular posterior shoulder with an outside diameter greater than the respective bore;
 - a convex rotational surface at an enlarged terminus of the drillstring connection having a diameter less than the sleeve and greater than the bore;
 - a posterior annular seat between the terminus and the shoulder comprising a matching concave rotational surface;
 - an anterior annular seat having an outside diameter to be received in the sleeve, a matching inside con-

cave rotational surface, and an inside diameter greater than an outside diameter of a longitudinal section of the respective drillstring connection sub; and

a retention nut threadably received in the sleeve to secure the annular seats and having an inside diameter larger than the outside diameter of the longitudinal section.

- [c45] The articulated top entry sub of claim 44 further comprising seals disposed between the convex rotational surface and the concave rotational surface of the posterior seat, and between an outside diameter of the posterior annular seat and an inside diameter of the sleeve.
- [c46] The articulated top entry sub of claim 45 wherein the annular shoulder of the sleeve and the outside diameter of the posterior annular seat are stepped to form an annular recess receiving a wear seal.
- [c47] The articulated top entry sub of claim 44 further comprising a wear sleeve disposed inside the lower drillstring connection sub at an upper end of the enlarged terminus.
- [c48] A wireline service method for a drill string comprising a top drive and a rotary table, comprising:

installing a top entry sub with opposing deflection knuckles into the drill string above the rotary table and below the top drive;

positioning the deflection knuckles to align an entry port of the top entry sub with the drill string below the top entry sub and offset the drill string above the top entry sub;

inserting a wireline tool suspended from a wireline through the aligned entry port into the drill string below the entry sub;

positioning the deflection knuckles to align the drill string above and below the entry sub and offset the entry port; and

operating the tool in the drill string below the entry sub with the wireline through the entry port.

- [c49] The method of claim 48 wherein positioning the deflection knuckles to align the top entry sub comprises vertically restraining the drill string at the rotary table and lowering the top drive.
- [c50] The method of claim 48 wherein positioning the deflection knuckles to offset the entry port comprises raising the top drive to tension the top entry sub in the drill string.
- [c51] The method of claim 48 wherein operation of the tool in

the drill string occurs while offsetting the entry port.

- [c52] The method of claim 48 wherein operation of the tool in the drill string occurs while aligning the entry port.
- [c53] The method of claim 48 wherein operation of the tool in the drill string occurs while aligning the entry port.
- [c54] The method of claim 48 further comprising applying torque via the rotary table to the drill string with the tool therein.
- [c55] The method of claim 48 further comprising reciprocating the drill string with the tool therein via the top drive.
- [c56] The method of claim 48 further comprising aligning the entry port for removal of the tool subsequent to the operation of the tool in the drill string.
- [c57] The method of claim 48 further comprising providing a hardened wear sleeve in the top entry sub to inhibit erosion by the wireline.
- [c58] The method of claim 48 further comprising aligning the entry port during deployment or retraction of the wireline through the entry sub to inhibit wireline erosion.
- [c59] The method of claim 58 further comprising stopping deployment or retraction of the wireline through the entry

sub when the entry port is offset to inhibit wireline erosion.